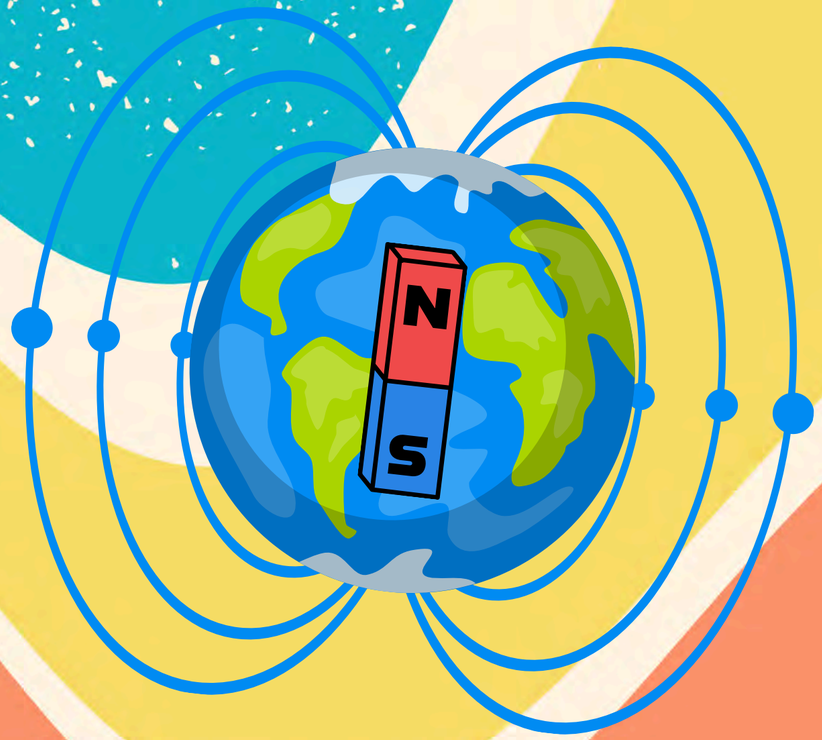
Forces from a Distance:

Far Out - Gravity and Magnetism!



Teacher's Pet

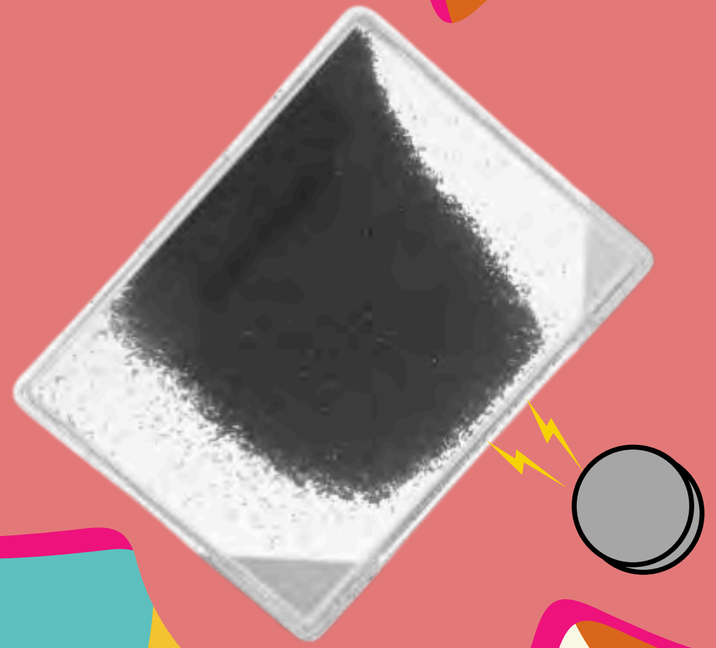
Non-Contact Forces

- Non-contact Forces are INVISIBLE forces that can affect objects, materials and substances at a DISTANCE

- Non-contact forces occur between objects that are not in direct contact

- DEMO: Levitating Globe

How do non-contact forces affect objects?



Gravity and Magnetism!

- DEMO: Iron Filings Plate
- Gravity pulls the iron filings DOWN
- Magnetism pulls the iron filings UP
- Iron filings display the magnetic field

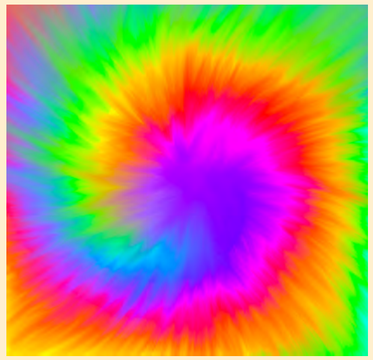
Activity 1: Gravity is Groovy!

How does gravity affect different objects?

Ball

Necklace

Bubbles



Cloth

Feather Earrings

Table 1: Gravity is Groovy!

Table 1: Gravity is Groovy

1. Drop a flat piece of paper from a height of 150 cm.
2. Using the timer, record the time it takes the paper to hit the floor. Complete 3 trials if time permits.
3. Repeat the experiment with folded paper and a scrunched paper ball.

Falling Object	Trial 1 Drop Time (sec)	Trial 2 Drop Time (sec)	Trial 3 Drop Time (sec)
Flat Paper			
Folded Paper			
Scrunched Paper Ball			

Prediction:

Circle the paper shape you think will fall the fastest below.

Flat Folded Ball

Testing Gravity in NASA's Vacuum Chamber

GRAVITY VIDEO

https://youtu.be/lkAjLM8ReEw?si=GGm-x5vV1Zy1Ub6-

Activity 1: Gravity is Groovy!

- Gravity on Earth is an INVISIBLE non-contact force that pulls objects towards the ground
- We demonstrated the effect of gravity on many objects
  - Gravity is a constant FORCE on earth
  - As gravity acts on objects from a DISTANCE, drag (air resistance) will slow them down

Activity 2: Magnetism is Magnificent!

How does magnetism affect objects?

Iron Fidget Spinner

Zinc Fidget Spinner

Activity 2: Magnetism is Magnificent!

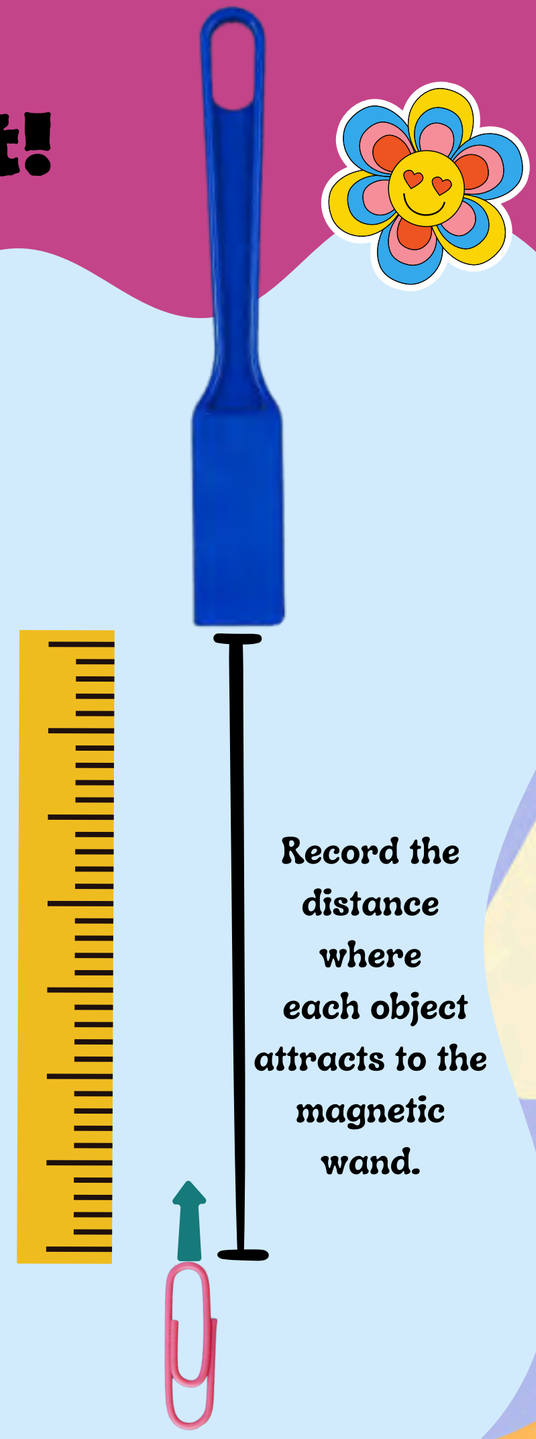
Table 2: Magnetism is Magnificent!

1. <u>Prediction:</u> At what DISTANCE (cm) will each object attract to the magnetic wand? Record your predictions in the table below. Use a "X" if you think the object WILL NOT ATTRACT to the magnet.
2. <u>Test:</u> Using the magnetic wand and a ruler, test the distance of the magnetic force.

Object	Predict Distance of Magnetic Force (cm)	Test #1 Distance of Magnetic Force (cm)	Test #2 Distance of Magnetic Force (cm)	Test #3 Distance of Magnetic Force (cm)
button magnet				
toy				
pipe cleaner				
cloth				
aluminum foil				
burger				
coin				
paper clip				
feather				
key				
magnet wand				

BONUS TIME ACTIVITY:
Place other materials between the objects and the magnetic wand (eg. wood, ruler, cloth).

Does the magnetic force act through these other materials? Why?



Record the distance where each object attracts to the magnetic wand.

3. Place PAPER between each object and the magnetic wand. Circle the objects above that still ATTRACT!

Activity 2: Magnetism is Magnificent!

Table 2: Magnetism is Magnificent!

1. <u>Prediction:</u> At what DISTANCE (cm) will each object attract to the magnetic wand? Record your predictions in the table below. Use a "X" if you think the object WILL NOT ATTRACT to the magnet.
2. <u>Test:</u> Using the magnetic wand and a ruler, test the distance of the magnetic force.

Object	Predict Distance of Magnetic Force (cm)	Test #1 Distance of Magnetic Force (cm)	Test #2 Distance of Magnetic Force (cm)	Test #3 Distance of Magnetic Force (cm)
button magnet	Note: Answers may vary for predictions and distances measured			
toy		X	X	X
pipe cleaner				
cloth		X	X	X
aluminum foil		X	X	X
burger				
coin				
paper clip				
feather		X	X	X
key				
magnet wand				

BONUS TIME ACTIVITY:
Place other materials between the objects and the magnetic wand (eg. wood, ruler, cloth).

Does the magnetic force act through these other materials? Why?

3. Place PAPER between each object and the magnetic wand. Circle the objects above that still ATTRACT!

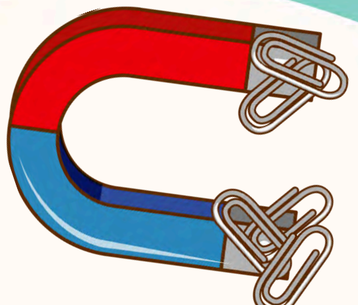
Activity 2: Magnetism is Magnificent!

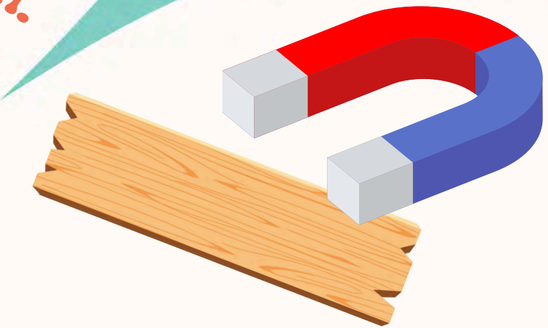
What have we discovered?

Magnetic force is a non-contact force that attracts or repels magnetic materials.

Strength of non-contact forces increase as objects get closer together.

Non-contact forces act through some materials like paper, wood, rulers & cloth.



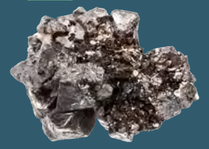


Activity 2: Magnetism is Magnificent!

What have we discovered?

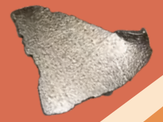
Magnetic materials: iron, cobalt & nickel

Iron



Nickel

Cobalt



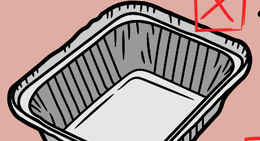
One magnet can **ATTRACT** or **REPEL** another magnet from a distance

Non-magnetic materials: wood, plastic, brass, aluminum, scarf & feathers

Wood

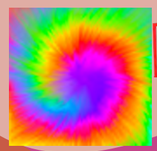
Feather

Aluminum



Plastic

Brass



Cloth

Electromagnetic Crane

Movement Break: Let's Get Groovy!

1. Each student gets <u>ONE</u> magnet card.

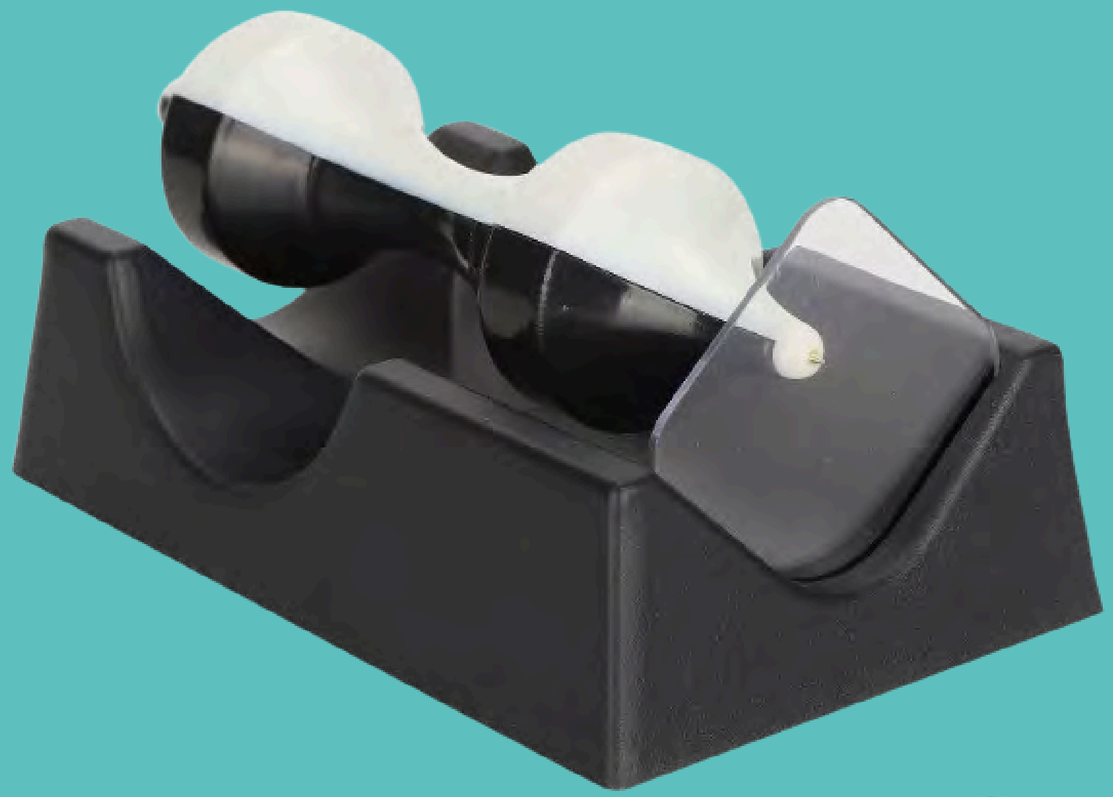
2. Cards show NORTH or SOUTH pole
3. Show the back of the card until instructed to FLIP it over

4. We will move around the room while listening for the instructions:
   - ATTRACT 
   - REPEL 
   - MAGNETIC CHAIN 

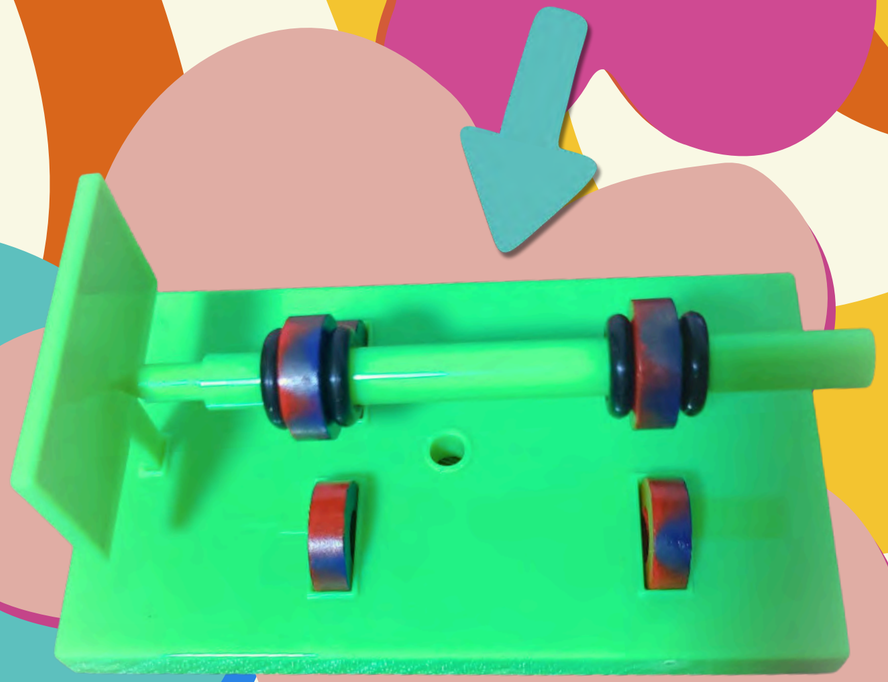
Activity 3: Far Out! Opposites Attract!

How do magnets interact with each other?

MagLev Spinner

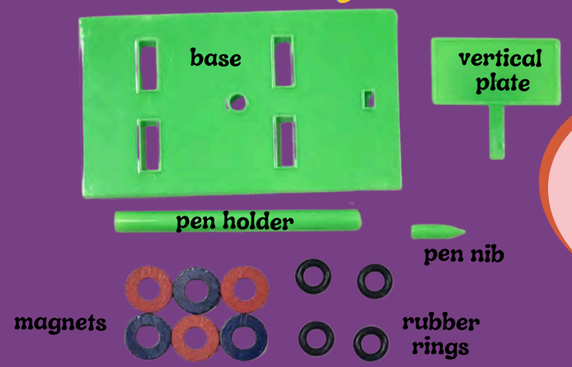


Take Home Project:
Levitating Pen



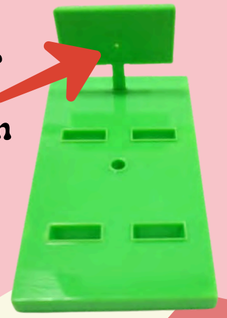
Step-by-Step Instructions: Levitating Pen

Materials



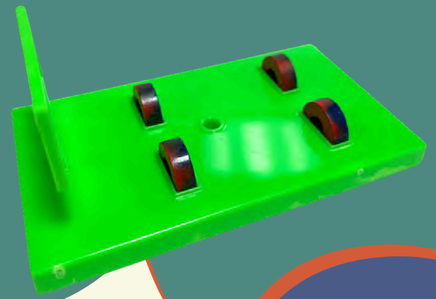
Step 1

Insert vertical plate in base.



Step 2

Place 4 magnets in the base. North poles (red) faces the vertical plate.



Step 3

Install nib on the pen holder.

Step 4

Slide the black rubber rings and magnets through pen holder in an alternating pattern. North poles should face tip of pen (same direction as magnets in the base).

Step 5

Slide to align magnets on the pen with the magnets in the base.

Step 6

Place the pen nib in the opening of the vertical plate and gently release to make the pen levitate!

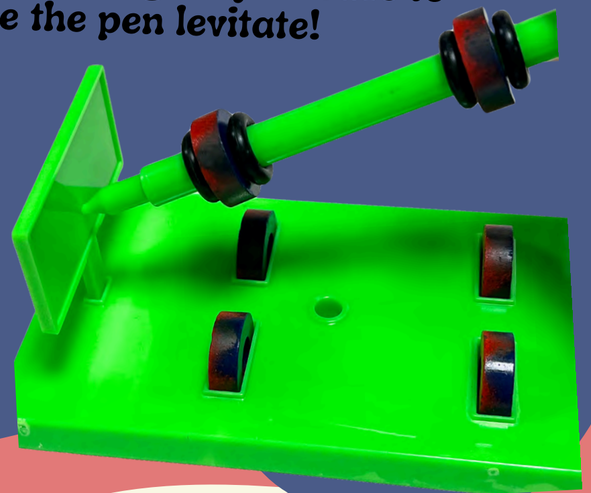


Table 3: Far Out! Opposites Attract!

MagLev Experiment	Observations What do you see and feel?	Explanation How do magnetism and gravity interact?
Levitating Pen 		

Table 3: Far Out! Opposites Attract!

What have we discovered about gravity and magnetism?

MagLev Experiment	Observations What do you see and feel?	Explanation How do magnetism and gravity interact?
Levitating Pen 	• Magnetic force pushes the spinner up • It floats and spins above the other magnets in the base	• Gravity is a non-contact force that pulls the spinner down towards the earth • Levitation occurs when magnetic force attracts and repels in very quick repeating cycles

Maglev Train

Activity 3: Far Out! Opposites Attract!

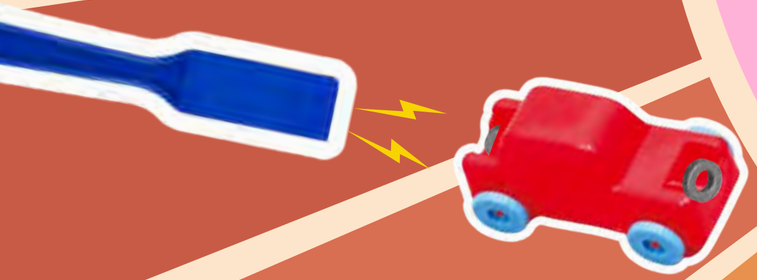
How do magnets interact with each other?

Magnetic Disc Spring

1. Set out the base plate.
2. Insert the cylinder in the end of the base.
3. Slide the magnetic discs onto the cylinder.
4. Try different disc arrangements until the disks create a magnetic spring.

Activity 3: Far Out! Opposites Attract!

How do magnets interact with each other?



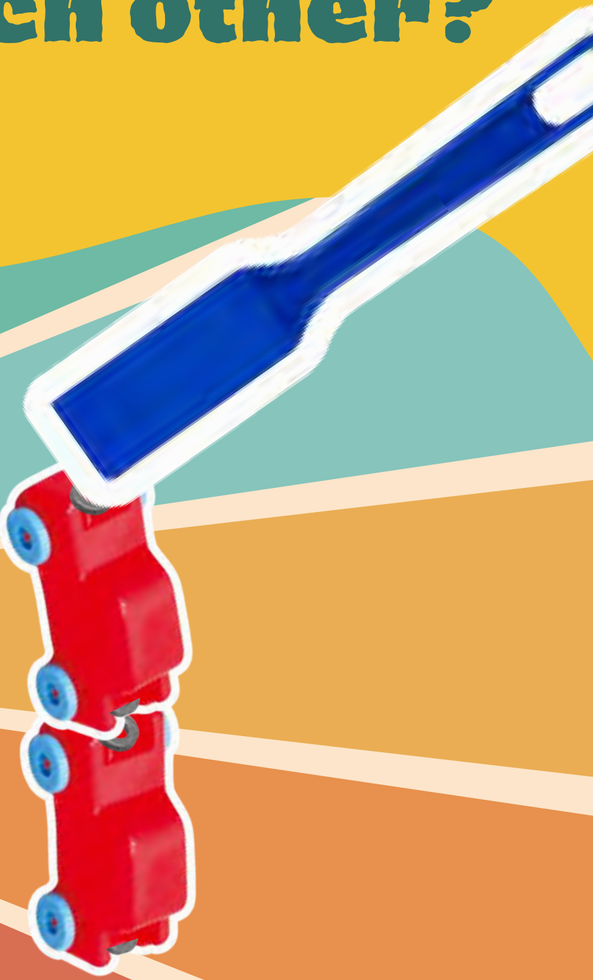
Magnetic Cars

1. Try to pull 1 or 2 cars with the magnet. Try to lift the cars up.

2. Try to push 1 or 2 cars with the magnet.

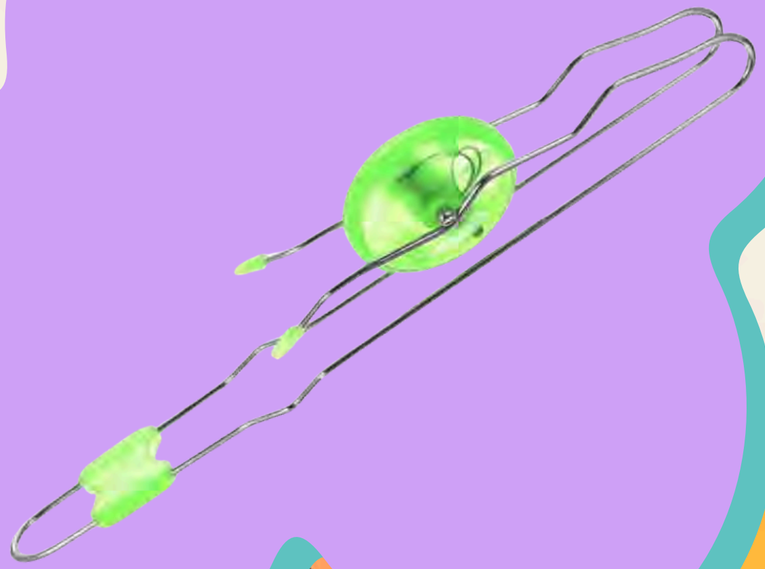
3. Join two cars together. Try rotating the cars in different directions.

4. Using magnets, race the cars across the table.



Activity 3: Far Out! Opposites Attract!

How do magnets interact with each other?



Magnetic Twirler

Keep the Magnetic Twirler moving along the track!

Take turns and share!

Activity 3: Far Out! Opposites Attract!

Table 3: Far Out! Opposites Attract!

1. Set up each magnetic experiment. Detailed instructions will be provided by your guide.
2. Record your observations and explanation in the table below.

MagLev Experiment	Observations What do you see and feel?	Explanation How do magnetism and gravity interact?
Magnetic Disc Spring 		

Activity 3: Far Out! Opposites Attract!

What have we discovered about gravity and magnetism?

Table 3: Far Out! Opposites Attract!

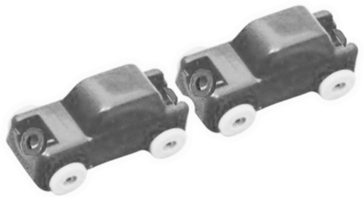
1. Set up each magnetic experiment. Detailed instructions will be provided by your guide.
2. Record your observations and explanation in the table below.

MagLev Experiment	Observations What do you see and feel?	Explanation How do magnetism and gravity interact?
Magnetic Disc Spring 	• Magnets have 2 poles: North and South • Opposite magnetic poles attract • Like magnetic poles repel	• Magnetic force is strongest at the magnetic poles • Invisible lines of magnetic force create a magnetic field • Magnetic force is stronger than gravity -- it levitates!

Magnetic Resonance Imaging

MRI

Table 3: Far Out! Opposites Attract!

MagLev Experiment	Observations What do you see and feel?	Explanation How do magnetism and gravity interact?
Magnetic Cars 		

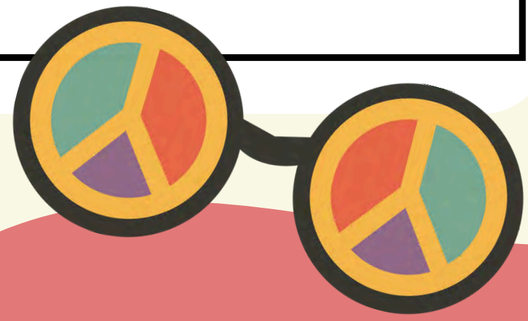
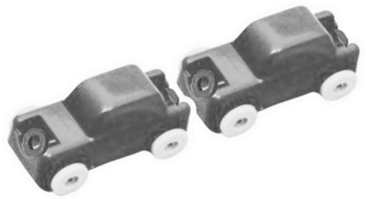
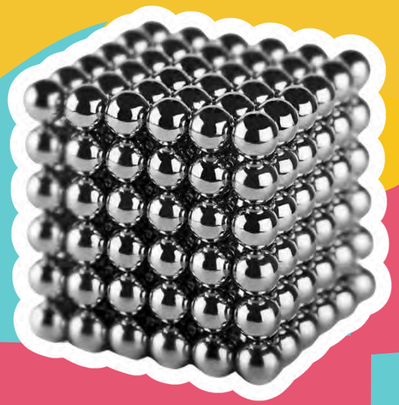


Table 3: Far Out! Opposites Attract!

What have we discovered about gravity and magnetism?

MagLev Experiment	Observations What do you see and feel?	Explanation How do magnetism and gravity interact?
Magnetic Cars 	• Cars can attract or repel each other • Magnets can push or pull cars	• Like (or the same) magnetic poles repel • Opposite magnetic poles attract • Magnetism can pull the cars up against the force of gravity

Magnetic Toys and Magnetic Art



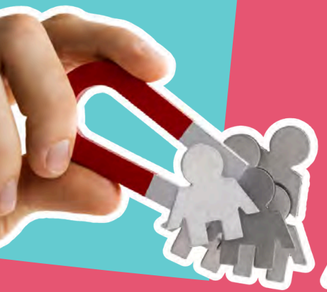
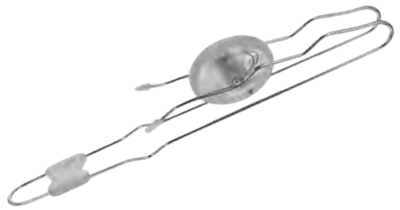


Table 3: Far Out! Opposites Attract!

MagLev Experiment	**Observations** What do you see and feel?	**Explanation** How do magnetism and gravity interact?
Magnetic Twirler 		

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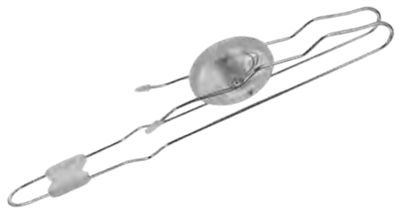
MagLev Experiment	Observations What do you see and feel?	Explanation How do magnetism and gravity interact?
Magnetic Twirler 	• Disc is attracted to the track • Discs lights up when it moves • Disc moves up and down as you rotate the track	• Magnetism attracts disc to the track • Completes electrical circuit • Gravity pulls the disc down • Magnetism is stronger than gravity when the disc moves up

Earth's Magnetic Field

Aurora Borealis

Activity 4: Mighty Magnetic Substances

How can you turn a substance into a magnet?

Table 4: Mighty Magnetic Substances

Magnetic Putty

Table 4: Mighty Magnetic Substances – Magnetic Putty

	Observations What do you see and feel?	Explanation How do magnetism & gravity interact?
Putty Not Magnetic		
Putty Becomes Magnetic		

Magnetic Chains

Table 4: Mighty Magnetic Substances

Magnetic Putty

Table 4: Mighty Magnetic Substances – Magnetic Putty

	Observations What do you see and feel?	Explanation How do magnetism & gravity interact?
Putty Not Magnetic	• Stretchy, gooey and slimy	• Iron particles scattered so NO magnetic force • Gravity pulls down on the putty to stretch it
Putty Becomes Magnetic	• Putty sits on a very powerful magnet • Thin fibers attract/repel a magnet	• Strong magnet pulls iron particles into alignment • Putty may defy gravity when pulled by a magnet • Chains form when magnetic force passes through iron

Magnetic Chains

Conclusion: Forces From a Distance

How are Gravity and Magnetism the SAME?

How are they DIFFERENT?

Gravity

- Pulls objects down to Earth
- Constant on Earth

Both

- Invisible
- Act without touching

Magnetism

- North and South poles
- Attracts or repels magnetic objects
- Opposites attract
- Stronger levitation

Take Home Activity:

Magnetic Groovy Putty